

Northern



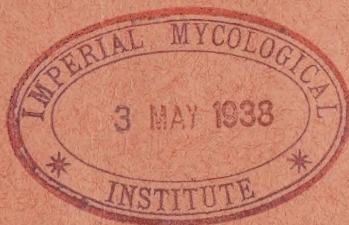
Rhodesia.

Department of Agriculture

ANNUAL REPORT

for the year

1937



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DEPARTMENT OF AGRICULTURE.

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Northern Rhodesia.

DEPARTMENT OF AGRICULTURE.

Annual Report for the Year 1937.

AGRICULTURE IN THE TERRITORY.

1. In the last report it was stated that no one had yet experienced a "normal" season in Northern Rhodesia. The statement still holds good. In the season under review the effective rains in the railway belt ended early. This had no great influence on maize which was generally well forward at the time, but it was disastrous in other directions. For the fourth successive season the annual rainfall in the railway belt has been low and "permanent" water supplies have been seriously reduced in consequence.

Maize.

2. A repetition of the bumper maize crop of 1935-36 could hardly have been expected. The average European production fell from 8.0 to 6.6 bags per acre, but only a few years ago 6.6 bags would have been regarded as very satisfactory indeed. As usual Chisamba led the field but Mazabuka yields showed less decline from the record crop of the preceding year.

3. The average yield during the period 1919-1931 was but 4.6 bags per acre. Since then yields have always exceeded 6.5 bags except during the two years when the effect of bad seasons was accentuated by locust damage. It seems probable that the normal yield of the future will lie between 6.0 and 6.5 bags, a factor which has an important bearing on the future of the industry.

4. During the latter part of the year the internal consumption of maize increased considerably. Current consumption is estimated at rather over 250,000 bags per annum, an increase of almost 25 per cent. over last year's figure. European acreage under maize has recovered steadily from the marked contraction in the years 1932-33 and 1933-34 and now stands at over 44,000 acres, which was the normal figure during the period 1926-31. With no further increase in acreage an *average* crop of about 280,000 bags must be expected in the future, from which can be deducted slightly more than one bag per acre for farm consumption. When allowance is made for the Native producers' share of the market (under the Maize Control Ordinance), in the absence of any further change in internal consumption production on this scale will result in an average annual surplus of about 45,000 bags of European maize. Export of the order of one bag in five should be profitable to the majority of producers at any except the lowest of export parity levels, but a narrowing of the ratio by increased production or by decline in internal consumption would seriously embarrass many, unless export parity remained at its present abnormally high level.

5. The general standard of farming has greatly improved in recent years. The acreage under green manures has risen from 8,500 in 1931 to 16,000 in 1937. It would be rash to associate the increased maize yields directly with the increase in green manuring, but there can be no doubt that farms on which green manuring is practised extensively are generally better managed than those on which it is not and, an important point in a country with such a short planting season, they are far better prepared for getting the maize crop in early.

6. The following is a comparative table of European maize production :

MAIZE PRODUCTION (EUROPEAN).								
		<i>Kalomo</i>	<i>Maza- buka</i>	<i>Lusaka</i>	<i>Chi- samba</i>	<i>Fort Jame- son</i>	<i>Other Dis- tricts</i>	<i>Total</i>
1936-37 :								
Acres planted	...	997	14,442	18,840	8,985	81	1,054	44,399
Yield in bags	...	5,606	110,729	100,950	71,645	494	5,039	294,463
Yield per acre	...	5.6	7.7	5.4	8.0	6.1	4.8	6.6
1935-36 :								
Acres planted	...	1,011	13,541	17,355	8,067	62	1,167	41,203
Yield in bags	...	6,916	114,518	121,721	78,862	454	6,182	328,653
Yield per acre	...	6.8	8.5	7.0	9.8	7.3	5.3	8.0
<i>Increase (+) or De- crease (—) in 1936- 37 :</i>								
Acres planted	...	—14	+901	+1,485	+918	+19	—113	+3,196
Yield in bags	...	—1,310	—3,789	—20,771	—7,217	+40	—1,143	—34,190
Yield per acre	...	—1.2	—0.8	—1.6	—1.8	—1.2	—0.5	—1.4

7. The economics of Native maize production have been revolutionised by Maize Control. Formerly only a fraction of the surplus available for sale in good years was actually purchased; now a cash market is available for every bag of maize a Native cares to bring in. It was estimated that the average purchase of Native maize during the three years prior to Maize Control was 58,000 bags per annum. This estimate included a figure of 100,000 bags for the year 1934-35, though there is some doubt as to whether lack of storage would not have prevented the purchase of anything like this quantity. In the first year of Maize Control, 234,000 bags of Native maize were handled. Complete figures for the current year cannot be given as delivery of the crop, unlike that of the European, is more or less continuous, but by the end of December, 161,000 bags had been acquired of which 26,000 bags were produced in the former season but not surrendered in that "pool year".

8. In the first pool-year the Control Board price for Native maize was 5s. per bag which, as it was fixed before the phenomenal rise in export parity, resulted in a profit of £17,000 on Native maize transactions. This sum is being held in reserve as a fund to stabilise prices. In the current year the price offered was raised to 6s. as there was no indication of decline in export parity and no justification for materially augmenting the reserve. Even 5s. cash represents an advance on the prices to which the majority of Natives had become accustomed and this, together with the certainty of disposal of the entire surplus, has given the industry a tremendous fillip. It remains to consider how far this fillip is really beneficial.

9. Most of the Native maize is produced in a limited area comprising the less remote and more fertile portions of Reserves XI and XIII. Reserve IX and parts of Reserve VI also contribute but on a much smaller scale. The main producing area also carries the highest concentration of Native cattle in the Territory. If fertility is lost by overcropping and erosion the Native maize industry will be crushed, for there is no other unalienated land within economic distance of the railway which could support maize growing on its present scale, as the crop is somewhat exacting in its soil requirements. There is grave danger that this may ultimately happen unless action is taken to prevent it. Proposals have been made for the preservation of this comparatively small region, which, due to its fertility and geographical position, is estimated to yield a Native income from agricultural and pastoral production fully double that of the remainder of the Territory.

10. The Native produces maize very cheaply, indeed with the majority the cash outgoings are negligible. As compared with the European, the Native can afford to export a much higher proportion of his crop at low export parity levels, and at present prices he would do fairly well even if his entire production were exported. If, therefore, successful measures can be taken to preserve the fertility of the maize soils, Maize Control will have been a tremendous boon. If measures are not taken or if they prove unsuccessful the last state of the Native industry will be worse than the first.

Wheat.

11. For the second successive year the wheat crop was a very poor one. Last year an unprecedented attack of rust was the trouble, this year there was practically no rust but water shortage ruined much of the crop. Only 2,524 acres were planted as compared with 4,249 in the previous year, but the water supply was insufficient even for this reduced area. Much of the acreage had to be grazed off as it obviously could never come to maturity. This abandonment brought the average yield down to 2.2 bags per acre (the normal yield is 5 bags), though the few farms which had adequate water produced reasonably good crops. The total production was only 5,504 bags, the smallest for many years. Of these, 890 bags were retained for farm consumption.

12. As a result of the severe rust attack of 1936 there has been a tendency to abandon the local *Red Klein Koren* wheat in favour of two varieties which suffered comparatively slightly in the epidemic. These varieties have been grown for some years on a small scale to the east of the railway line where rust is more prevalent, and they are known locally as "Kenya Bearded" and "Kenya Beardless". The former is known also by its true name, *Sabanero*, and the beardless type is probably *Kenya Governor*. Neither of these varieties have the yielding capacity or quality of *Red Klein Koren* and the change, at least in the case of *Sabanero*, is one of doubtful wisdom.

13. *Sabanero* was, for a time, popular in Kenya on account of its rust resistance, but it has now fallen from favour as it has poor baking qualities and is not liked by millers. It was found to be a thrifty wheat on poor soils but it did not thresh out as well as it promised in the field. This characteristic has already been noted by some Lusaka growers.

Potatoes.

14. A 50 per cent. increase, bringing production up to 5,500 bags, has made the Territory practically self-supporting in potatoes from the middle of February until August, the period when the main crop comes on the market, and any further increase in main crop potatoes is to be deprecated. There is, however, room for considerable expansion in the various irrigated crops for at present the market is largely supplied by importation from the Union from August to February. A glut of early main crop potatoes in Southern Rhodesia resulted in an initial quotation of 5s. per bag f.o.r. Salisbury. Actually very few of these potatoes were imported but the repercussion on local prices caused much consternation. As the result of an interview with the Salisbury Potato Pool in early March, the Pool most helpfully agreed to refrain from supplying the Northern Rhodesia market until our own crop had been absorbed. After some anxiety local growers did, in fact, succeed in disposing of their crops at reasonable prices.

Groundnuts.

15. There was a further substantial decrease in European groundnut acreage but the total production of 2,000 bags (unshelled) was rather larger than that of the former year. As a European crop groundnuts are not directly remunerative and maize soils rarely give good yields. In consequence it is now a crop of negligible importance in European agriculture. With Native production the situation is entirely different. Most Native areas contain soils admirably suited to the crop and the scheme for supplying the internal market, which was mentioned in the last report, has had a stimulating effect. The certainty of being able to sell the crop has led to increased production, though this has not all gone to supply the local market as a shortage in Southern Rhodesia diverted a portion of it to that Territory.

Tobacco : Fort Jameson.

16. Climatically the season was a poor one. The early rains were rather too copious and they ceased abruptly at the beginning of March, stunting the development of the crop and causing the abandonment of much late planted tobacco. In spite of this, the district as a whole enjoyed the best season it has had for years. The harvested crop was free from disease and of good quality and the prices obtained were the highest since the boom of 10 years ago.

17. Probably rather over one million pounds of leaf were sold but shipment has not yet been completed. Customs figures for export up to the end of the year are as follows :

Southern Rhodesia	...	...	214,617 lbs.
Union of South Africa	...	...	342,969 lbs.
Overseas	...	...	354,977 lbs.
<i>Total</i>	...	...	<u>912,563 lbs.</u>

Voluntary auction sales were again held successfully. Approximately 292,000 lbs. were sold at these for the overseas market.

18. There has been a further welcome decrease in transport charges. It is now possible to consign tobacco from Fort Jameson to London at an inclusive cost of £16 per short ton, and there is hope that even this figure may be reduced by the development of motor transport from Fort Jameson to Salisbury.

Tobacco : Railway Belt.

19. Tobacco growing in the Railway Belt continued to hang fire until the end of the year when a revival of interest occurred. This revival is undoubtedly due to the appointment of Mr. Cowling as Secretary-Grader to the Choma Co-operative Society—an appointment which is subsidised by Government in order to provide advisory services which could not be undertaken departmentally in the Railway Belt. The crop produced during the year was entirely absorbed by the Union quota and realised good prices. If all goes well next year's production should be nearly treble that of 1937.

20. Mr. Cowling reports that much leaf has been lost in the past through incorrect cultivation (especially the final cultivation), indiscriminate topping, over-ripeness, and inadequate and unsatisfactory curing accommodation. The attention of planters has been drawn to these defects, and now that a regular advisory service has been provided improvement will almost certainly follow.

21. The following is a comparative table of flue-cured tobacco production :

VIRGINIA TOBACCO (FLUE CURED).

				<i>Railway Belt</i>	<i>Fort Jameson</i>	<i>Total</i>
1936-37 :						
Acres planted	...	...	...	121	3,355	3,476
Yield in pounds	...	...	...	45,000	1,142,000	1,187,000
Yield per acre	...	...	...	372	340	341
1935-36 :						
Acres planted	...	...	...	129	3,127	3,256
Yield in pounds	...	...	...	52,000	1,149,000	1,201,000
Yield per acre	...	...	...	403	367	369
<i>Increase (+) or Decrease (—) in 1936-37 :</i>						
Acres planted	...	...	...	—8	+228	+220
Yield in pounds	...	...	...	—7,000	—7,000	—14,000
Yield per acre	...	...	...	—31	—27	—28

In addition, 56,000 lbs. of sun-cured leaf were produced at Fort Jameson and 17,000 lbs. of Turkish leaf in the Railway Belt.

Coffee.

22. At Abercorn a further 41 acres of coffee were established and 9 were abandoned. The total area under cultivation is 416 acres and there is little hope of substantial increase until more capital is brought into the district. Yields were again very low at an average of 210 lbs. per acre, but this is partly due to former bad treatment of the older estates. Most of the young coffee, which has yet to come into bearing, has been well-treated from the start and should make a much better showing.

23. A co-operative roasting and tinning factory has now been established at Abercorn to place prepared coffee on the local market in satisfactory condition. The plant is a modern one and the preliminary tests have turned out a product of uniform excellence.

Locusts.

24. All reports received during the year referred only to the Red Locust and it would seem that the swarm phase of the Tropical Migratory Locust had disappeared entirely.

25. Local breeding was confined to an area lying between latitudes 14 degrees and 16 degrees south and longitudes 27 degrees and 31 degrees east. Within these limits egg-laying swarms were still active in January and hopper bands appeared in February. Though scattered over a wide area these bands were invariably small and loose, and damage to crops by hoppers was negligible.

26. Most of the bands became winged early in May and during that month there was a westward drift of small locally bred swarms, generally little more than loose aggregates of fliers. No damage to crops was caused by this migration. The westward drift came to an end fairly rapidly. During the latter part of June and the whole of July very few swarms were reported.

27. There was a fresh and somewhat disquieting development in August when large and dense swarms appeared in the east of the Territory. Early in the month swarms of great size were observed moving up the Luangwa Valley, and later other large swarms, which seem to have come from Nyasaland, moved in a westerly direction through the Isoka District. This movement continued through Isoka during the first few days of September and then came to an end. It would appear that the invading swarms continued their westerly flight as far as the Luapula Valley and then turned northward, for during September several large swarms passed northwards through the Kawambwa District. Large swarms, showing a westerly flight tendency, also appeared in the Mazabuka District, and during the first week of September four such swarms were seen on or near the railway line between Mazabuka and Pemba.

28. During October swarms were reported only from Kasama, Petauke and central Barotseland, but in November several large swarms from the north entered the Mwinilunga District. Egg-laying was said to have started in the Broken Hill District before the end of November.

29. The position at the end of the year was still somewhat obscure but it seems probable that few swarms remain in the Territory and that little egg-laying has taken place. Disease and parasitism were again inactive and no reports were received of mortality among hopper bands or flying swarms during the year.

THE WORK OF THE DEPARTMENT.

30. There was no change in the European establishment during the year and one case of severe illness caused some disorganisation. It is impossible to ensure continuity at three widely separated agricultural stations with three Agricultural Officers. Happily a new appointment has been provided for in the 1938 Estimates.

31. Construction work occupied much of the time of the staff at the two new stations, Lunzua and Pemba. At Lunzua permanent quarters were erected for the Native staff and labourers, and a house for the Agricultural Officer was started. Permanent quarters for the Agricultural Officer and for the assistant to the Cotton Officer were built at the Pemba station. All these buildings were erected departmentally.

32. Forestry continued to be administered as a sub-department. The year's work is recorded at length in Part II of this report.

The Ecological Survey.

33. The report of the Ecological Survey on North-Western Rhodesia was published early in the year. It is unquestionably a most useful document to the Administration and to this Department, and it appears to have excited much wider interest.

34. The survey of North-Eastern Rhodesia was begun in March and by the end of the year the country north of the line Mafupa-Luwingu-Kasama-Isoka had been covered.

35. Mr. Clothier's survey of Reserves II and IV in the Fort Jameson District has been followed up by a visit by Dr. Dixey, Director of Geological Survey, Nyasaland. Dr. Dixey has submitted a valuable report on the improvement of the water supplies of these Reserves.

Agricultural Advisory Board.

36. During the year I presided over a sub-committee of the Agricultural Advisory Board appointed to investigate the possibility of developing export crops. The report was published in June. The major possibilities of development were considered to be confined to coffee and tobacco production by Europeans, and for Natives to maize, cotton and groundnuts. The necessity for the temporary establishment of a Marketing Board to handle Native export products at cost was stressed, as it was considered that the difficulties peculiar to the building up of an export trade in Northern Rhodesia were too great for private enterprise. One very popular recommendation, which has since been adopted, was that the petrol tax should be removed in order to cheapen road transport.

37. This is the third major report which has been produced in the last three years—the first two dealt with the Maize Industry and Replacement of Imported Produce respectively. Their preparation has involved a good deal of time and trouble which, however, has been amply repaid by the results of action taken on the recommendations. It was hardly to be expected that the reports would add to departmental knowledge, but the confirmation of departmental views by an impartial and representative body has been both useful and encouraging, and the reports have swept away many popularly-held misconceptions.

Flue Cured Tobacco.

38. Departmental work on flue cured tobacco is centred at the Fort Jameson station. For some years it has been held that tobacco grown from newly imported seed does not thrive in its first season, that in the next year it may be expected to give a heavy crop of good quality leaf and that in subsequent years there is an increasing tendency to coarseness and late ripening. The results of the last two years have confirmed this view, and it is now clear that the station can serve a useful purpose by importing seed annually and by supplying planters with seed from selected progeny. The maximum benefit from the scheme will, of course, only be obtained if planters purchase their seed requirements from the station every year.

39. *White Stem Orinoco*, which was introduced by the Department some years ago, is still the most popular variety, but there has recently been a revival of interest in *Willow Leaf*. The latter has been shown to be a satisfactory type for the district, but it is impossible to say at present whether a general change over from *White Stem Orinoco*, which does well and meets the requirements of the manufacturer, would be desirable.

40. The following rotation was tentatively chosen when work first started at the station: Tobacco (fertilised); Tobacco (fertilised); Sunnhemp (ploughed in); Maize.

This has worked fairly satisfactorily for six seasons. It is being continued in one field while in another a modification is being tried. In this the sunnhemp is to be cut and composted, the compost being applied to the maize and the second tobacco crop.

Native Tobacco.

41. Towards the end of the year the Agricultural Officer, Fort Jameson, established trials near the Mvuvye River, some 140 miles from Fort Jameson, to ascertain the possibility of introducing tobacco as a Native cash crop. The local conditions of soil and climate appear to resemble those of the tobacco producing areas of Nyasaland. Two types are being tried—fire cured and the so-called “sun-and-air” cured. The departmental plot is four acres in extent and, in addition, nine half-acre plots are being cultivated by villagers under a guarantee scheme. The work is being supervised by a Native Demonstrator with considerable experience of tobacco production in Nyasaland.

Coffee.

42. The manurial trials with coffee at Abercorn, stake planted as a randomised block of eight replications in 1932 with treatments starting in 1935, was harvested for the first time. The age of the trees at the time of harvest was $4\frac{1}{2}$ years from seed.

43. The results are tabulated below. The treatments were as follows :

- A. Control (no treatment).
- B. 10 tons compost plus 150 lbs. Nicifos No. 3 per acre.
- C. Cover crop.
- D. Cover crop plus 10 tons compost per acre.
- E. Vegetable mulch.
- F. Vegetable mulch plus 10 tons compost per acre.
- G. 10 tons compost per acre.
- H. 20 tons compost per acre.

PLOT YIELDS (*lbs. per acre of clean coffee*).

			TREATMENTS.							
Blocks.			A.	B.	C.	D.	E.	F.	G.	H.
1.	Sandy Soil	... ..	229	615	78	340	607	499	307	322
2.	Sandy Soil	... ..	363	1,015	196	298	546	622	447	372
3.	Sandy Soil	... ..	347	687	171	258	232	556	162	366
4.	Contact Soil	... ..	289	391	304	255	763	948	741	672
5.	Red Soil	... ..	253	324	105	165	192	316	108	157
6.	Red Soil	... ..	118	342	24	183	294	511	234	424
7.	Lateritic Soil	... ..	69	284	90	70	91	156	141	133
8.	Lateritic Soil	... ..	58	256	130	66	190	294	247	156

MEAN YIELD PER ACRE (*lbs.*).

			No Mulch or cover crops	Mulch	Cover crop	Nicifos
No compost	... ..	...	216	364	134	—
10 tons compost	... ..	...	298	488	204	489
20 tons compost	... ..	...	325	—	—	—

General mean : 315.3 lbs.

Standard error for above table : 45.9 lbs.

(Where the difference between yields exceeds 137.7 lbs. [three times the standard error] it is regarded as significant.)

44. An inspection of the table shows that the main responses are to mulching and to the application of compost plus Nicifos. With a perennial crop the result of the first year's harvest can only be regarded as an indicative, but combined with detailed observation on the trees and on others not included in the experiment, it is possible, even at this stage, to make some fairly definite statements.

45. Mulching has very materially increased yields, whether applied with or without compost. The "mulch only" plots show no sign of die back and have set another heavy crop. The "compost plus mulch" plots gave uniformly high yields which the trees bore well. Both in this experiment and elsewhere it has been found that mulching encourages vegetative growth and keeps the trees in good condition. It should form the basis of all manurial treatment. The value of mulching is enhanced where irrigation water is not ample. The plots which were cover-cropped have given lower yields than the corresponding series which were not so treated. Although the yield differences are not statistically significant, the condition of the trees has steadily declined since the treatment began and it may be said definitely that cover-cropping is detrimental under local conditions.

46. The application of Nicifos plus compost has produced a very considerable increase in yield but it is impossible to determine to what extent this is due to the Nicifos alone or to the interaction of the two manures. On these plots the plants are neither big nor leafy. A number showed signs of overbearing, but since the second application of Nicifos they have made remarkable recovery.

47. The effect of the application of compost is more doubtful. There is no significant reaction even to a dressing of 20 tons per acre. The difference in yield between the "compost plus mulch" plots and the "mulch only" plots also falls short of significance. It must not, however, be assumed that these results disprove the value of compost. They merely fail to prove, under the conditions of this experiment, that compost has definitely increased yields, and the question of its value remains open.

48. It was realised at the time of their establishment that the series of treatments left much to be desired in the way of completeness, but it represented all that could be undertaken if an answer were to be given to the three important questions of the day—the comparative effects of mulching, composting and cover-cropping. Even so, some of the blocks, notably 7 and 8, had to be established on land which would normally be avoided. Some revision of the treatments is now desirable in order that the effects of mulching, compost and Nicifos may be ascertained singly and in combination.

49. It has therefore been decided to discontinue the two cover-cropping treatments and to substitute "mulch plus Nicifos" and "Nicifos alone". The two treatments will start under an obvious disadvantage and future results will be indicative only, but it is thought that more information will be gained by making the change than if the cover-crop treatments were continued. The "20 ton compost" plots have also largely served their purpose and on these the future treatment will be an annual dressing of Nicifos, compost and mulch.

White Borer of Coffee.

50. Our knowledge of the life history, under local conditions, of White Borer (*Anthores leuconotus*) has been increased through the courtesy of Mr. J. H. Venning, who has supplied figures for the borer larvae and eggs extracted on his estate in 1937. Mr. Venning's estate has been much more seriously attacked than the station by this pest, possibly on account of its lower altitude. His results confirm those previously obtained at the station except that small larvae and eggs were found much later in the season. Of the total extractions of small larvae 68 per cent. were made from January to March, and 27 per cent. from April to June. Corresponding figures for egg extractions were 93 per cent. and 6½ per cent. Mr. Venning has also been conspicuously successful in reducing infestation by the systematic collection of adult beetles during November and December.

Other Coffee Pests.

51. The simple control measures recommended by the Entomologist have been successful in checking *Gonocephalum*, and no damage from this pest has been recorded during the year. A minor pest, the Yellow Borer (*Dirphya* sp.), was recorded for the first time. A life history and suggested control measures have been circulated to planters and little or no damage has occurred.

Wheat Trials.

52. A natural request from the Lusaka wheat growers for the establishment of rust resistance trials presented some difficulty, as the Department has no irrigable land in the Railway Belt nor any officer stationed near the wheat producing area. Arrangements were made to establish trials at Lusaka through the courtesy of Mr. T. C. Zunkel who kindly offered land for the purpose, but unfortunately these had to be cancelled at short notice owing to lack of water. It was impossible, at that stage, to make other adequate arrangements to test the large collection of varieties and strains which had been acquired. As far as rust resistance is concerned, this was of little consequence as stem rust failed to appear in the district. In order to preserve the varieties small plots were established at Mazabuka and hand watered. The soil was known to have a high lime deficiency and despite a heavy application the yields were poor. Varietal differences were swamped by extreme soil variation and all that can be said is that *Kenya Governor*, *Florence* and *Union 52* did better than the remainder.

Cotton.

53. The experience with cotton gained during the year was both exasperating and gratifying. An unprecedented attack of *Dysdercus fasciatus*, while throwing doubts on the prospects of a hitherto promising region, did much to confirm the

suitability of other areas for cotton growing ; and although world prices fell 50 per cent. and show no early prospect of substantial recovery, the hollow satisfaction that this would have been much more serious had it happened in a few years' time is at least afforded.

54. Work proceeded on the lines indicated in previous reports in the Mumbwa, Mazabuka and Kalomo Districts. In addition, preliminary trials were conducted in the Luangwa Valley by the Agricultural Officer, Fort Jameson. The low lying valley areas were expected to be more suited to cotton than the Plateau owing to their longer growing season, and the Luangwa results certainly bore this out. Unfortunately the valley regions are somewhat remote and inaccessible, and it may prove that the obstacle to the development of a cotton-growing industry in them will be more economic than agronomic in nature. On the other hand, in the less remote Plateau regions the short growing season gives the plants only one chance of maturing a crop ; the hope of recovery from severe insect attack is slender and the crop may be completely destroyed. The special importance of a complete understanding of the relationship between soil, plant and pest at the higher altitudes will therefore be appreciated.

Cotton in Plateau Regions.

55. The dominant feature of the season on the Plateau was the exceedingly severe attack of the Stainer, *Dysdercus fasciatus*, which was recorded in every area. This attack was due to the exceptionally poor and late flowering of the chief host plant, *Thespesia rogersii*, and the consequent early migration of the Stainer population from the trees. *Transitional* and *Isoberlinia-Brachystegia* soils, where *T. rogersii* is comparatively sparse, have hitherto been troubled little by *D. fasciatus*, but this year their immunity disappeared. The host records indicate that this was due to the breeding of the *Thespesia* migrants on early flowering types of *Hibiscus asper* and the movement of the F.I. population to cotton. This interpolation of a generation on *H. asper* has hitherto been unrecorded. The effect of this attack varied greatly in different districts, as will be seen from the yield figures (seed cotton) which are given below.

56. In Reserve XI (Transitional soils) the crop on 100 plots scattered throughout the Pemba area was virtually destroyed, the highest yielded being only 91 lbs. per acre while the mean was 24 lbs. On the northern border of the Reserve the failure was less dramatic. Here there were seven plots, of which three on heavy dambo soils were practically destroyed, but the remaining four on a light loam of high fertility gave an average yield of 268 lbs. per acre of marketable cotton. Staining was, however, very severe and little more than one-third of the crop picked was clean.

57. Near Kalomo (*Brachystegia* soils), owing to the opposition of the local chief, few volunteers were found to grow cotton. Of these only one cultivated his plot and that somewhat sketchily. The one plot which was cultivated yielded at the rate of 206 lbs. of clean cotton per acre as compared with 500 lbs. from the same land in the previous year, the difference being due rather to soil exhaustion and poor cultivation than to the stainer attack. Two Mission plots, grown on the same soil type, yielded respectively 580 and 490 lbs. per acre.

58. In the Mumbwa District (Northern Transitional and *Isoberlinia* soils) the standard of cultivation was generally high and the earlier plantings, on the whole, gave satisfactory yields. On the light "Mutondo" soils the yields, though low, were very uniform and there were few failures, such as there were being mainly due to planting on ironstone soils. The highest yield on pure "Mutondo" soils was 340 lbs. per acre and the mean 224 lbs. for the earlier plantings (before December 15th). The mean for all plots was 193 lbs. More variable results were obtained on the heavier Transitional soil types, where the earlier plantings gave a maximum yield of 668 and a mean of 226 lbs. per acre, the mean for all plantings being 174 lbs. Picking was generally bad. Stained and clean cotton was lumped together and it was therefore difficult to estimate the amount of staining. Where plots had been properly picked two-thirds of the crop was clean and the remainder stained but marketable cotton.

59. Over all these areas the stainer attacks were closely comparable, and there can be little doubt that the differences in yield and degree of staining were due to the effect of soil differences on the development of the plants. This aspect

of the problem, the interrelation of soil, plant and pest, requires further investigation. The future of cotton growing on the Plateau would seem to lie in selection of suitable soils, early planting, early thorough cultivation and the use of strains capable of producing an early flush of flowering on poor soils. In view of this need for early flowering types suited to local conditions, two sub-stations have been established in the Northern (Mumbwa) and Southern Transitional (Pemba) zones, at which trials of numerous varieties and strains are being made.

Cotton in Valley Regions.

60. The trials made by the Agricultural Officer, Fort Jameson in the Luangwa Valley gave very promising results, particularly in view of the fact that the crop was quite new to the natives concerned. Due largely to careful supervision by Mr. Fraser the general standard of cultivation was remarkably high. One plot yielded at the rate of 1,000 lbs. of seed cotton per acre while the average of 20 half-acre plots was 385 lbs. per acre.

61. Preliminary surveys, particularly with regard to stainer hosts, were made in parts of the Luangwa and Zambezi (Kalomo-Guimbe) Valleys. The two valleys are very similar in their vegetational characteristics and the same hosts were found to be present. New trial plots have been established over a considerable area of the Guimbe Valley and at Nyimba in the lower Luangwa Valley (Petauke District).

Prospects of Cotton Growing.

62. The severe *Dysdercus fasciatus* attack has come opportunely in providing a much clearer picture of cotton prospects at a stage when set-backs are relatively immaterial.

63. The first complete failure in the Pemba region, where cotton is badly needed as a rotation crop, is disappointing since it casts considerable doubt on the suitability of this area. On the other hand certain of the Kalomo and Mumbwa soils have shown their ability to produce fair crops even under a very heavy attack of *D. fasciatus*. That the Native of these areas is satisfied with the results has been shown by a sudden increase of interest in cotton growing and an unexpected demand for seed.

64. It was not easy to arrive at a decision on the policy to be adopted in the new season. On the one hand there was evidence of the first real enthusiasm for cotton growing which it would be fatal to damp, and on the other there was the imperative need to "go slow" in areas the suitability of which was open to doubt and there was the sudden slump in values. Hitherto we have purchased seed cotton at prices based on 6½d. per lb. for lint in Liverpool. This was not, and perhaps may still be not, too optimistic an average figure, but it is much too high at the moment. An established cotton growing industry might be able to struggle along on the present low prices, but it would be hopeless to endeavour to *develop* an industry by giving the Native exactly what his cotton is worth in Northern Rhodesia to-day. It was ultimately decided to permit sufficient expansion to keep enthusiasm alive and to continue to pay former prices for at least one more year. The actual amount of loss will be trivial even if there is no early recovery in values, and it would clearly be folly to permit what may prove to be a temporary slump to sound the death knell of the industry immediately after its birth. However, should cotton be entering on a long period of low prices a halt will have to be called unless the growers are content to continue at rates based on the true value of their crop—a very doubtful matter.

65. The growth in the number of growers is illustrated in the following table :

Area					Number of Growers			
					1934-35	1935-36	1936-37	1937-38
Pemba	...	...	...	...	4	30	101	160
Mumbwa	...	...	...	...	4	11	74	220
Kalomo	...	...	...	...	4	11	10	70
Namwala	...	...	...	...	3	10	10	—
Livingstone	...	...	...	...	—	14	—	—
Sianjalika	...	...	...	...	—	—	7	45
Luangwa Valley and Nyimba	...	...	...	...	—	—	20	55
Guimbe Valley	...	...	...	...	—	—	—	50
<i>Totals</i> ...					15	76	222	600

66. During the year Professor Munro and Mr. Parnell visited Northern Rhodesia in the course of a tour of the cotton growing territories of Central and Southern Africa, undertaken on behalf of the Empire Cotton Growing Corporation to advise that body on the progress of the pest control work it was financing. The visit was timed most opportunely as far as this territory was concerned as the unprecedented attack of *D. fasciatus* gave a good indication of the magnitude of the problems facing us. Professor Munro was deeply impressed by the excellence of the work of Messrs. Allan and Bebbington and the published record of his impressions is greatly appreciated.

Beeswax.

67. In 1933 the Ecological Survey drew attention to the possibility of developing beeswax production in parts of North-Western Rhodesia, and the areas of potential supply were roughly mapped on the basis of the distribution of important bee trees. Since then the industry has received Government encouragement through the District Commissioners in most of the areas of potential supply and, as will be seen from the following table of export, this has been remarkably effective.

<i>Exports of Beeswax</i>				
<i>Year</i>			<i>Cwts.</i>	
Average 1928-1933	...	...	12	
1934	...	...	6	(Low production due to defoliation of bee trees by locusts.)
1935	...	...	73	
1936	...	...	500	
1937 (six months only)	...	...	609	

68. Most of this wax was produced in the Balovale and Mwinilunga Districts and it is known that, in addition, considerable quantities for which there is no customs record were carried across the border by Natives and traded outside the Territory. There has so far been little development in North-Eastern Rhodesia and the beeswax areas of that region have not yet been mapped. There are, however, large tracts from which good supplies of wax should be obtainable.

69. Up to the present year action had been confined to the stimulation of interest among Traders and Natives and to posting untrained instructors, practising traditional methods of wax preparation, in potential but non-producing districts. This certainly resulted in increased production, but in general the quality of the wax brought in was very poor (in Mumbwa District the weight of impurity was as high as 34 *per cent.*). Remelting and cleaning by Traders was, of course, necessary.

70. In June, Mr. Allan, Entomologist, visited Tanganyika Territory and studied methods of preparation and marketing of beeswax through the courtesy of the Tanganyika Government. In addition, two Native assistants attended the Annual Bee-keeping Course at Morogoro. On their return, Mr. Allan organised a course of instruction at Mumbwa which was attended by pupil-instructors from the following districts: Balovale, Mwinilunga, Kasempa, Mumbwa, Sesheke and Serenje.

71. It was decided to aim at production of "saucers" of clean wax by the Natives themselves. These saucers require no further treatment before export, they can be made with little extra trouble and require no apparatus that cannot be found in most Native households. Wax so prepared is much more valuable than the impure "ball" wax produced at present. The additional melting, which tends to impair quality, is avoided; there is no mixing of waxes of different colours, and impurities are readily detected.

72. It is axiomatic that the success of any scheme to improve the quality of a product depends on securing to the producer a premium for his extra trouble, and it is recorded with pleasure that some traders have been quick to appreciate the enhanced value of "saucer" wax and to pass the premium on to the producer. At the present state of the market the Native should receive from 6*d.* to 8½*d.* per lb. for clean saucers depending on the position of the buying centre, and this range of prices is actually being paid by traders in the Mumbwa, Mwinilunga and Ndola Districts.

73. Beeswax is one of the few products which can stand transport from remote areas and, a most important point, its production is particularly suited to districts in which the scanty and scattered distribution of population rules out the development of an agricultural industry. It is estimated that North-Western Rhodesia could produce an average of about 200 tons of wax a year. The industry is obviously well worth nursing for, as a Native export product, beeswax ranks next to maize in its promise.

Sampling of Native Maize Gardens.

74. During the year an effort was made to estimate with some degree of accuracy the yields of maize obtained by Native cultivators in a Reserve (XI) near the railway line. The work was carried out by Mr. Johnson who, unfortunately, was also busily engaged in brick-making and building and could therefore only sample 23 gardens, all of them in the neighbourhood of the Pemba Agricultural Station. Nevertheless this preliminary survey, which included an investigation into the history of the gardens, has given some very interesting indications. In particular it shows how completely traditional Native agriculture has given place to a system approaching continuous maize cultivation.

75. The sampling gave an estimate of $3\frac{1}{2}$ bags per acre for the average maize yield, but too much significance must not be attached to a figure based on a survey of only 23 gardens and these in one region. As an indication of general yields, the estimate is probably too high as soils and the standards of cultivation in the region sampled are probably somewhat above the average.

76. On the more fertile types of "thorn" and "sweet dambo" soils, continuous maize cultivation over long periods is the rule, but good thorn soils are still capable of yielding over 6 bags per acre after 8 years of this treatment. The better class of dambo soils gave yields exceeding 9 bags in the second year of cultivation, while one old garden of this type, said to have been in continuous cultivation for 15 years, gave the unexpectedly high yield of $3\frac{1}{2}$ bags per acre.

77. The light "transitional" loams, the most commonly cultivated soils of this area, give good initial yields but deteriorate more rapidly under semi-continuous maize cultivation. On these soils legumes are commonly inter-planted with maize; groundnuts and groundbeans being inter-planted in the first year and cowpeas in the later years. Pure culture of legumes is confined to comparatively small plots. Kaffir corn is still occasionally, but rarely, grown in rotation with maize. Yields on these transitional soils varied from $9\frac{1}{2}$ bags in the second year to 2 bags in the 8th year, while two gardens on poorer transitional soils gave yields as low as $\frac{1}{4}$ and $\frac{1}{2}$ a bag per acre after a few years of cultivation.

Improvement of Agricultural Methods.

78. Apart from departmental work on the development of economic crops, investigation into the improvement of agricultural method is being carried out at the Lunzua (Abercorn) and Kanchomba (Pemba) stations. In addition, early in the year Lieut.-Col. S. Gore-Browne, D.S.O., M.L.C., generously agreed to finance a sub-station on his estate at Shiwa which will be run in conjunction with the Lunzua station. Mrs. Gore-Browne has kindly offered to take charge of the work and she becomes, in effect, an honorary Agricultural Officer.

79. The general purpose of the Lunzua Station is to devise alternatives to the traditional "Chiteme" practice, in order to check the complete deforestation of certain neighbouring Reserves which will be inevitable if "Chiteme" is continued without modification. Complementary work has been started at Shiwa but here the local problem is rather different as there is no acute shortage of trees. Nutrition in this region is notoriously deficient and the main work at Shiwa will lie in the direction of devising means, within the capacity of the Native cultivator, whereby he may improve his diet in quantity and variety.

80. Only two cropping seasons have yet been completed at Lunzua and as the first of these was devoted mainly to uniformity trials, there is little to be reported at this stage. The remarkable effect of compost on the yields of "Male" (*Eleusine coracana*) has, however, been confirmed. In one experiment plots of Male receiving no treatment gave an average yield of 848 lbs. per acre as compared with average yields of 2,246 and 1,490 lbs. from plots receiving 20 tons and 10 tons of compost

per acre respectively. All plots had been cropped with "Male" in the previous year. The fact that the increment in yield due to an extra 10 tons of compost was no less (actually slightly more) than that obtained from a single 10 ton dressing, emphasises the need of these soils for organic matter. Application of compost in April gave slightly better results than that applied in December. Eighty-seven "varieties" of male, many of which proved to be synonyms, were grown in observation plots and 14 were selected for further trial.

81. At the Kanchomba (Pemba) station the first year's cropping was devoted to uniformity trials. About 15 tons of compost were made from January to March from 10 head of cattle under a simple system which might be applicable to Native agriculture in the district. The compost is satisfactory in appearance and its effect on maize is now being tested. Towards the end of the year a Native demonstrator was posted on his own land a few miles from the station. Six acres of land have been contour-ridged and will be cropped under a rotation incorporating maize, groundnuts and cotton. The maize has been manured this year as no compost was available; in subsequent years compost will be applied if the results at the station justify this innovation. In addition, two acres have been reserved for a residential site, kraal and orchard.

Publications.

82. The following papers were published during the year :

The Soils, Vegetation and Agricultural Systems of North-Western Rhodesia (Report of the Ecological Survey), by C. G. Trapnell and J. N. Clothier.

The Pest and the Plant, by A. G. Bebbington and W. Allan : E.C.G.C. Review XIV, 1st January, 1937.

LEGISLATION.

83. Amendments to agricultural legislation were made as follows during the year :

The Maize Control (Amendment) Ordinance, 1937.—This Ordinance adds to the powers of the Maize Control Board by enabling the Board to issue participation certificates of guaranteed value to traders.

The Importation of Plants (Amendment) Regulations, 1937.—Under these regulations the importation of citrus fruit from Portuguese East Africa, except that from Citrus Canker areas, is permitted.

Ephestia ellutella Hb. was added to the Schedule of Plant Pests and Diseases (Tobacco) Regulations. This pest has not yet been recorded in this Territory but it was thought desirable to extend the powers of Agricultural Officers to include search for it on private property.

REVENUE AND EXPENDITURE.

84. The recurrent expenditure of the Department, exclusive of Forestry and Ecological Survey, but including the entire administrative charges, has been roughly as follows in recent years :

	1932-33	1933 (a)	1934	1935	1936	1937
Administrative and Clerical	£3,300	£2,100	£1,500	£1,500	£1,500	£1,500
European officers employed	6	3	2	2	2	2
Field Work	£14,300	£7,400	£3,000	£4,000	£5,000	£6,000
European officers employed	14	11	3	3	4	4
<i>Total</i>	<i>£17,600</i>	<i>£9,500</i>	<i>£4,500</i>	<i>£5,500</i>	<i>£6,500</i>	<i>£7,500</i>
<i>Total European officers employed</i>	<i>20</i>	<i>14</i>	<i>5</i>	<i>5</i>	<i>6</i>	<i>6</i>

(a) Estimate based on whole year.

85. Revenue is naturally small. In 1937 about £300 was received from the sale of agricultural produce, and a contribution of £480 towards the cost of the cotton experiments was made by the Empire Cotton Growing Corporation. In addition, the Corporation again seconded one of their officers for work in the Territory. Their continued assistance is most gratefully acknowledged.

86. Non-recurrent expenditure of £830 was authorised to provide for a house at Lunzua for the Agricultural Officer. In addition a new vanette was provided at a cost of £170.

PART II.—FORESTRY.

INTRODUCTION.

87. The progress made during the year, while not spectacular, was real and the modest achievements were attained in the face of considerable staff difficulties caused by leave and sickness. In the Northern Division activities were concentrated mainly on the training of Native staff (which was doubled in number during the course of the year), closer control over cutting in Crown forest, and in the reconnaissance and demarcation of Forest Reserves. In addition, the results from experimental work were of unusual importance and promise. The Southern Division suffered more from shortage of staff, which was particularly unfortunate in an abnormally bad fire season, and much of the work was of a non-recurrent nature incidental to the establishment of new Forest Headquarters on the Machili.

88. The European staff was posted as follows :

J. D. Martin, Assistant Conservator : Southern Division, January-June.
On leave July-December.

C. E. Duff, Assistant Conservator : Northern Division, January-December.

R. G. Miller, Assistant Conservator : Northern Division, January-June.
Southern and Northern Divisions, July-December.

G. R. Martyn, Forester : Southern Division, January-December.

89. The Native staff consisted of 25 Forest Guards and 1 Clerk in the Northern Division and 10 Forest Guards in the Southern Division. In addition, 13 Forest Guards were employed in the Barotseland forests and paid from the Barotse Forest Fund.

LEGISLATION.

90. A much needed revision of the Forests Ordinance was taken in hand in the middle of the year. A draft was compiled for an entirely new Ordinance, which will follow fairly closely those of Nyasaland and Tanganyika. The draft is still under consideration.

91. A conference attended by the acting Attorney-General, the Commissioner for Mines and departmental officers was held in March to discuss the bearing of the new draft Mining Law on Forestry. As a result of two days' discussion, it was recommended that amendments should be made to certain of the clauses of the Law which refer to taking of timber. Briefly, it was proposed that prospectors and mining location holders should, in future, be liable for payment of royalty on timber taken from Crown Land, and they should be compelled to observe reasonable felling rules prescribed by Forest Officers. The conference was of great value to the Department as it cleared up a number of important legal points on which we were previously in doubt.

DEMARCATON OF FOREST RESERVES.

92. Four Forest Reserves in the Northern Division were gazetted during the year. These are :

Broken Hill Fuel Reserve.—Two blocks of *Isoberlinia* woodland, 7,593 acres and 21,180 acres in extent, lying east and south of Broken Hill, within good reach of the Mine. (*Gazetted* under Government Notice No. 160 of 1937.)

Mufulira Forest Reserve.—An area of very dense *Isoberlinia-Brachystegia* and *Marquesia* woodland, 7,920 acres in extent, adjoining the new township of Mufulira. (*Gazetted* under Government Notice No. 64 of 1937.)

Nkana "C" Area Forest Reserve.—26,622 acres of land, most of it densely wooded and containing several sub-types of *Isoberlinia* woodland and of transitional woodland on good soil. (*Gazetted* under Government

Notice No. 61 of 1937.) This extensive area, close to the largest of the copper mines, will ultimately prove one of our most valuable sources of timber.

Chichele Swamp Forest.—5,300 acres, including over a square mile of marsh. (Gazetted under Government Notice No. 29 of 1937.) The Reserve lies near Ndola, it is traversed by a railway and a main motor road, and as it contains much soil well suited to tree growth, it will be one of the first of the Copperbelt Reserves to come under treatment when funds are made available for large-scale planting.

INDUSTRIES AND EXPLOITATION.

The Zambesi Saw Mills.

93. The lease granting to the Zambesi Saw Mills Ltd. the right to exploit about 300 square miles of *Baikiaea* forest in an area of 5,500 square miles in the Sesheke District, was finally signed in June, after more than 3 years of negotiation. Under this lease considerably higher financial returns will be obtained from the forests than from those exploited recently, but the returns will still fall below the estimated requirements to protect and manage these forests. Of the revenue which will be obtained, £750 per annum will be paid during the period of the lease to the Barotse Native Treasury and the balance will be funded to provide for the preservation of the best of the forests.

94. The new lease contains more satisfactory fire protection and felling regulations than its predecessors. More power of control over girth limit is provided and, by subsequent agreement, the girth limit at breast height was raised from 40 inches to 47 inches for all *Baikiaea* trees yielding more than one sleeper length, *i.e.* with 14 feet or more of clean bole. This should do much to provide a better stocking in the forests when they are next exploited, and it eliminates one of the worst forms of wastage during the present exploitation.

95. During the first half of the year the Zambesi Saw Mills continued the exploitation of Lonze Forest in one of the *Baikiaea* areas known as Yeta's Forests, which, although situated in the Livingstone District, are by treaty reserved to the Paramount Chief. Immediately after the signing of the new lease operations were transferred to Kanyanga Forest in the Sesheke District, leaving unexploited some 20 square miles of Yeta's Forests which lie conveniently near Mulobezi mill to serve as an emergency reserve. Exploitation of Kanyanga Forest, which is only 5 square miles in extent, was completed in December and the Company moved into the adjoining and equally small Nanga Forest. During the first part of the year timber was also obtained from Bechuanaland Protectorate through a sub-contractor who has now ceased operations.

96. The volume of timber in the round (almost totally of *Baikiaea plurijuga*) which the Zambesi Saw Mills handled from these various sources was as follows :

From Lonze Forest	...	...	...	...	1,758,000 cubic feet.
From Kanyanga and Nanga Forests (Sesheke District)	...	...	...	...	1,525,000 cubic feet.
From Bechuanaland	...	...	...	...	380,000 cubic feet.
<i>Total</i>	...	...	...	...	<u>3,663,000 cubic feet.</u>

97. The sales of sawn timber during the year amounted to nearly 1,200,000 cubic feet. Approximately 1,000,000 cubic feet of this took the form of railway sleepers, over two-thirds of which were supplied to the Rhodesia and South African Railways, the balance being used for mining sleepers principally in the Union of South Africa. Sales of parquet blocks, strips and flooring totalled 86,000 cubic feet. Some 10,000 cubic feet of parquet flooring strips were exported overseas. These shipments were well received and there appears to be every prospect of the continuance of the export of this material on perhaps an increased scale.

98. The Company's mills were fully occupied for most of the year. The average numbers of employees throughout 1937 were 95 Europeans and 4,000 Natives.

99. Some years ago the Zambesi Saw Mills made an exhaustive investigation into the possibility of producing a commercial tannin solution from the waste wood and bark of *Baikiaea plurijuga*. The tannin content was proved to be satisfactory, but an undesirable colouring matter defied all efforts to remove it from the solution. In the past year the Company turned their attention to the local tanning of hides and manufacture of leather. They have produced some experimental foot-wear and leather goods, but a considerable amount of preliminary work has yet to be done before these can be produced on a commercial scale.

Mining Timbers.

100. No marked change is to be reported in the consumption of local timber by the Copper Mines, except that an increase of 20,000 cords of fuel wood was cut this year for brick burning and boiler wood alone. On Crown Lands, 25,000 mining sleepers (100,000 cubic feet in the round) were cut at Chondwe siding for sleepers for Nkana Mine, and another 10,000 cubic feet of trolley sleepers were cut on private land near Ndola. At Kapako, on the Congo Border, 55,000 cubic feet of mining poles and roughly 1,500 cords of firewood were sold to a Belgian contractor for Kipushi Mine. These represent considerable increases on last year's figures.

Furniture and Joinery.

101. Considerable quantities of furniture and joinery are made by the Zambesi Saw Mills. In the Copperbelt the building of new Government townships at Kitwe (Nkana) and Mufulira, swamped the sawmill at Ndola with orders for joinery. About 10,000 cubic feet of seasoned local timber, chiefly *Pterocarpus* (Mukwa), was converted into joinery for new buildings. Consequently nearly all the joinery and furniture required for considerable additions to the Mines' own townships was made from imported timbers.

Firewood.

102. Apart from the sales from Forest Reserves reported under paragraph 130 no large scale firewood licences were issued this year. The bulk of domestic firewood supplies continues to be drawn from private land. It was found at Ndola and at Mufulira that buyers preferred firewood cut and corded by departmental labour to cutting it themselves, but it has not yet become clear whether the forests near the towns will be worked more economically by departmental cutting than by selling the wood standing. Misundu Lime Works, an important consumer of fuel wood, ceased cutting on Crown Lands at the end of the year and started felling its supplies on a neighbouring private estate.

EXPORTS AND IMPORTS.

103. The following tables show the value (in country of origin) of the exports and imports of wood and manufactures thereof during recent years. The unavoidably early preparation of this report has prevented the inclusion of full figures for 1937. During the year prices of imported Douglas Fir and American Pitch Pine rose considerably which led to the purchase of as much sawn hardwood timber as could be obtained from the Belgian Congo at short notice. The Congo wood was used largely for joinery and, in the mines, for special purposes such as truck bodies and chute boxes.

		EXPORTS.						
		1931	1932	1933	1934	1935	1936	1937
		£	£	£	£	£	£	£
Unmanufactured	...	4,236	9,674	11,634	20,903	25,964	31,498	Six
Partly manufactured	...	178	73	309	1,245	2,247	776	months
Joinery ...	...	91	514	347	79	138	110	only
Furniture ...	...	4,248	9,256	6,222	1,039	428	996	
Other Manufactures	...	26,993	3,858	4,538	1,351	1,677	1,937	
Railway Sleepers	...	*	17,826	31,291	39,557	74,476	107,633	
<i>Totals</i> ...	...	35,746	41,201	54,341	64,174	104,930	142,950	56,873

* Included under "Other manufactures".

IMPORTS.

		1931	1932	1933	1934	1935	1936	1937
		£	£	£	£	£	£	£
Unmanufactured ...	...	58,502	29,293	29,264	41,294	24,392	35,679	Six
Partly manufactured	...	10,361	2,304	2,646	2,754	2,666	1,482	months
Furniture ...	...	43,181	9,527	8,375	12,867	9,642	7,890	only
Joinery ...	...	27,277	4,232	1,867	4,202	4,167	2,873	
Other manufactures	...	12,464	6,137	5,940	10,632	4,492	6,003	
<i>Totals</i>	...	151,785	51,493	48,092	71,149	45,359	53,927	36,864

REVENUE AND EXPENDITURE.

104. Revenue and expenditure since the inception of the Forest Service is given in the following table :

<i>Year</i>		<i>Gross Revenue</i>	<i>Expenditure *</i>
		£	£
1928-29	...	2,458	641
1929-30	...	3,757	1,376
1930-31	...	850	1,854
1931-32	...	417	2,740
1932-33	...	423	2,997
1933 (9 months)	...	316	2,366
1934	...	693	2,298
1935	...	1,040	3,540
1936	...	1,345 (+1,327)	3,250 (+1,327)
1937 (estimated)	...	1,800 (+1,300)	3,800 (+1,300)

* No share of the cost of administrative headquarters of the joint departments is included in the table of expenditure.

105. It must again be explained that the sudden drop in revenue in 1931 was due to the exhaustion of the more accessible *Baikiaea* Crown forests. Exploitation was then transferred to 'Yeta's Forests' from which no revenue accrues to Government. On the other hand, the more efficient control of Crown Forests, which increased staff has rendered possible, is reflected in the recent rise in revenue.

106. The figures in brackets refer to Barotse Forest Fund. Expenditure has hitherto been financed by advances from the Treasury which will be recovered from the Fund. Six months exploitation of the Barotse Concession yielded roughly £2,100 by the end of the year. Of this £750 accrues to the Barotse Native Treasury and the balance goes to the Fund.

DIVISIONAL OPERATIONS: SOUTHERN DIVISION.

107. The work of the staff in this Division is almost totally confined to the *Baikiaea pluijuga* (Mukushi) forests of Livingstone and Sesheke Districts, which support the large saw-milling industry operated by the Zambesi Saw Mills, Ltd.

Reconnaissance.

108. From the log of an aerial flight to Mongu further data was added to the map of the *Baikiaea* forests on the Njoko River. No other original reconnaissance was carried out, but during road traverses and enumeration surveys additional details on general vegetation were noted. In December the Zambesi Saw Mills spotted from the air another apparently extensive area of *Baikiaea* north of those already mapped at the headwaters of the Njoko, and this is now being examined on the ground by that firm.

Enumeration Surveys.

109. During March and April a 1½ per cent. enumeration survey of *Baikiaea* resources was carried out in Malavwe and Nangulube Forests, which adjoin the Barotse-Namwala Cattle Cordon within 15 miles of Mulobezi mill. The survey showed that, excluding 3 square miles of forest already ruined by native cultivation, the area contains approximately 25 square miles of intact forest of which over

20 square miles are of good quality. In the latter, the number of exploitable *Baikiaea* trees (*i.e.* over 40 inches girth at breast height) ranges from 10 to 15 per acre, and there are also from 15 to 25 trees per acre between 10 and 40 inches girth.

110. Nanga Forest, an area of 5 square miles of *Baikiaea*, was enumerated on a 3 1/3 per cent. sampling in November, but the figures from this survey have not yet been analysed.

111. The enumeration survey of Situmpa Forest, which was begun in 1936, did not progress further until the end of the year, when additional lines were cut doubling the area to be enumerated, to give a sampling of 2½ per cent. At the same time the original lines were re-opened and the survey of the forest will be completed early in 1938.

Silviculture.

112. Comparison of the *Baikiaea* seedlings in Taungya plots at Bombwe and from spot sowings in other open sites, with those sown amongst the natural or partially cleared undergrowth seems to show that the more open the conditions the more rapid is the growth. Even at Bombwe, where the natural growth is of poor quality, the growth rate of 5 year old seedlings in Taungya plots averages nearly 1 foot per annum. Seedlings from spot sowings amongst the very heavy undergrowth in the same forest have not developed at a third of this rate.

113. The five Taungya plots of roughly half an acre each, which were established in the *Baikiaea* forests near Sesheke at the end of 1936, gave very varying results. One of these plots produced a 50 per cent. stand (approximately 650 plants per acre) and the others had percentage stands of 0, 1, 4 and 10 respectively. Rodents were responsible for most of the losses, but it is somewhat difficult to account for the outstanding success of the one plot. At present this can only be attributed to the extra care and attention given by the cultivator, who twice filled up the blanks during the first growing season. The worst of the five plots has now been abandoned and resowing of blanks was carried out in the remainder during December.

114. Thanks to a grant from the Carnegie Trustees, Mr. J. D. Martin, while on leave, has been able to study at the Imperial Forestry Institute a collection of soil samples from a wide range of *Baikiaea* forests in the Livingstone and Sesheke Districts. It is hoped that this investigation will throw some light on the hitherto unaccountable differences in the quality and character of these forests.

Fire Protection.

115. The dry season of 1937 was a particularly difficult one for fire-protection. The previous rains ended six weeks earlier than usual and the total fall was low. Sickness and staff changes at the busiest time aggravated the difficulties, and the unavoidable incompleteness of the work was reflected in the amount of damage which occurred during the season.

116. The worst damage took place in the *Baikiaea* forests on the Machili River, where practically the whole of the 150 square miles of forest was burnt through at one time or another. The first of these serious fires started during the actual fire-protection operations in April, and the last took place in October. As it is now likely that the Mulobezi saw mill, a centre for large numbers of both resident and itinerant Natives, will remain in this neighbourhood for many years, much more exhaustive fire-protection plans will have to be prepared for these forests.

117. Throughout the remaining 200 square miles of *Baikiaea* forest in the Sesheke District, fire-protection was very successfully carried out by the forest organisation of the Native Authorities. In these unexploited forests the area damaged by fire amounted to between 1 per cent. and 2 per cent. of the total.

118. In the Livingstone District the Native organisation has not yet attained the same efficiency. Since the inception of this scheme it has not been possible to give it the attention which accompanied the inauguration of the Sesheke scheme, and neither the work nor its cheapness have been so satisfactory. The task of the Livingstone Native Authorities is, however, more difficult as they are less powerful bodies and have in their charge a considerable proportion of recently exploited forest. Of some 130 square miles of *Baikiaea* forest outside the Machili basin

which they protected during 1937, nearly one-fifth was damaged by fire, and the cost was hardly less than if the work had been done more efficiently under direct departmental control.

Native Forest Laws.

119. The Sesheke Native Forest Organisation has, so far, derived its powers from pre-existing Native laws. In co-operation with the District Commissioner, Sesheke, a draft forest law suitable for the district was produced. This draft has been accepted by the Native Councils at Sesheke but has not yet received the approval of the Central Authority at Lealui.

120. In March, Mr. Martin presented to the conference of the District Commissioners of Barotseland a paper which described existing forest conditions and suggested measures for the more complete protection and control of the forests by the Native Authorities. In the past the Authorities under the Paramount Chief have exercised a rudimentary control over certain trees and forests through local indunas or councillors, and this has already been built up in the Sesheke District into what is virtually a Native Forest Service. The paper proposed to extend this scheme to the rest of Barotseland with, as its main objects, the protection of economically valuable forests and species, the protection of fruit-bearing trees and the control of bush cultivation. To secure these objects additions to the existing Native Forest Laws were suggested and a draft code for the whole Province covering forest resources, protected species, control of felling, early burning, and the appointment, powers and duties of forest indunas was submitted. The proposals were approved in principle by the conference and by the Central Native Authority. Consideration of details has been held up pending Mr. Martin's return from leave.

Roads and Buildings.

121. The construction of the Machili station was resumed during the dry season. The unfinished parts of the Assistant Conservator's house were completed, an unpretentious but comfortable three-roomed brick house was built as Forester's quarters, and a rough office and store were erected. The compound accommodation was also improved and further clearing was carried out.

122. Road construction continued throughout the year. 25½ miles of road were made up departmentally from forest headquarters toward the *Baikiaea* forests on the Cattle Cordon, at a total labour cost of just over £2 per mile. This work was brought to a close during the dry season on account of scarcity of water.

123. With the assistance of the District Commissioner, Sesheke, 65 miles of road were made between Machili and Sesheke Boma, and to link the former directly with the road prepared last year between Sesheke and Katima Mulilo. A simple pontoon was devised for the crossing of the Machili River. The component pieces of this were prepared by the Saw Mills and then transported to the site for assembly at a total cost of approximately £5. No permanent fixtures were erected at the Loanja River, the only other difficult crossing on this road, as it is first desirable to observe the water-flow during the present rainy season.

124. The Sesheke-Katima Mulilo road was maintained in passable condition, and a few additional miles of clearing near Katimo Mulilo linked the existing roads with an open valley which needed no further preparation to provide a dry-weather route of 22 miles encircling Muchinga Forest.

125. In the construction of these roads the level and ubiquitous sand renders unnecessary much attention to formation or drainage, but the determination of the best alignment is all important to avoid waterlogging on the one hand and heavy clearing and impassable loose sand on the other. In this matter, Mr. Martin's vegetation surveys, amplified by the detailed knowledge of local Natives, have been invaluable.

126. The main roads connecting Sesheke Boma with Machili and Katima Mulilo have now been adopted as district roads, and will in future be maintained by the Administration.

DIVISIONAL OPERATIONS: NORTHERN DIVISION.

127. This Division lies between the Kafue River and the Congo Border. The bulk of the work is naturally concentrated in the Copperbelt—the main consuming centre.

Reconnaissance.

128. A short preliminary tour in the dense bush country between Ndola and Mufulira brought to light only one small exploitable forest in a total traversed area of 250 square miles. Two tours late in the season completed a general reconnaissance of 2,000 square miles of bush along the railway belt and the Congo border, south of Ndola. This region has been investigated piecemeal at odd times since 1933. Proposals were submitted for declaring 100 square miles of this area, along the Congo border, a protection forest for the Kafulafuta headwaters. Two further forests totalling 20 square miles and containing good sized *Isobertinia tomentosa* (Mutobo), *Brachystegia hockii* (Muputu) (up to 8 feet girth) and *Entandrophragma caudatum* (Mofu) were proposed as timber reserves. Most of the more urgent reconnaissance of Crown forest along the railway have now been completed. The Department should in future be free to concentrate nearly all its reconnaissance work on the Copperbelt and northern Congo border, where extensive and thorough reconnaissances are urgently required.

Forest Management.

129. Early burning was done in all forest reserves by Forest Guards, but it was carried out systematically only in Lusaka, Broken Hill, Chondwe, Chichele and Ndola West Reserves. Early burning was also carried out on exploited areas of Crown Lands, in the clear-felled areas at Misundu, in the logged-over bush at Chondwe, and in the pole coupes at Kapako. Properly organised this early burning was highly successful in preventing disastrous late fires.

130. At Lusaka over 2,000 cords of firewood were sold from the South Fuel Reserve and the Lenje Native Reserve Fuel Area. There was no difficulty in disposing of the prescribed annual yield of 1,000 cords from the latter, but transport restrictions and competition from private landowners keep the annual cut in the former much below the figure for sustained yield. Until regeneration has been more fully studied and surveys for development have been completed, no particular effort will be made to increase the annual cut as long as the annual costs of protection are covered. The early cessation of rains, and the late occurrence of frost enabled early burning of areas under regeneration to be carried out in the interval more successfully than in previous years. A few cases of late fires, started maliciously, were reported, but damage from these was slight, as they were either quickly put out by Forest Guards or died within a short distance of their origin.

131. In the new Broken Hill Fuel Reserve protection and patrol work was organised and a partially trained Native staff operated satisfactorily under the supervision of the District Commissioner. The Reserve boundaries were further cleared, two compounds were built and a number of coupes were laid out during the dry season. This Reserve includes three square miles in which Broken Hill Mine has been cutting firewood for the last three years, under Special Licence. The felled coupes were successfully early burned and the Mine cut and removed 1,500 cords from this area.

132. Belts, three chains wide, were clear felled along the northern boundaries of Mufulira Forest Reserve in order to define these boundaries. The wood so cut was sold. The work was still in progress at the end of the year.

133. Much time was spent in supervising exploitation in Crown Forests and the issue of licences. The patrolling of Crown Forest against unlicensed cutting was extended to Chisamba. Four coupes, covering a total area of 1,600 acres, were marked out on the Congo Border near Kipushi Mine and a valuation survey was made of the mining poles therein. Toward the end of the year preparations were made for the sale of 680 acres of firewood valued at £1,100 in a belt along the frontier opposite Kipushi Mine. Inspections were also made of the sleeper and furniture timber fellings on Crown Land at Chondwe.

134. Mufulira Copper Mine clear felled over a square mile of bush on Luansobe Extension, a special mining grant at some distance from the Mine. Royalty

was remitted, but the trimming of stumps to encourage coppicing, and the piling of crownwood and slash, had to be enforced under departmental supervision.

135. At Ndola 40 acres of mixed *Isoberlinia* woodland, regrown from Native cultivation in the remote past, were treated under a heavy improvement felling. All good stems and good species were left, and the rest was converted into cordwood, which met with a ready sale. These improvement fellings yielded on an average 10 cords (1,280 cubic feet stacked) of sound fuel-wood per acre.

136. The increase in Native staff has gone a long way to reduce the damage being done to Crown Forests near the townships by unemployed Natives. The Administration has almost completely stopped squatting and cultivation, and though much unnecessary damage is still done to young growth by Natives living in or near the towns, it is nothing like as serious as it was two years ago. How far we have still to go to make the Natives forest conscious will best be realised from the fact that this year, an unusually good one for wild fruits, hundreds of felled trees, especially of *Anisophyllea* spp., were counted in different parts of the Copperbelt. These had been cut down by Natives in order to get fruits from upper branches. It does in fact appear to be a common practice among the Natives in this industrial region to fell any fruit tree if they find it in full bearing.

Silviculture.

137. The routine maintenance, measurement and inspection of five series of experiments at Ndola were executed satisfactorily. These experiments had been laid down at different times since 1933. They are aimed at showing the effects of early burning, late burning and complete fire protection, upon increment, upon the development of seedlings under high cover, and upon coppice regrowth in clear-felled and grassbound areas. They include also "Improvement Fellings" of varying intensity, and methods of crown wood disposal to avoid the bad effects of fire in the dried crowns. Results are already becoming apparent. The clear-felled plots burned late every dry season still carry practically no regrowth, and seem to be steadily degenerating to grass since being felled four years ago. Adjacent and identical plots burned early in the season now carry a dense regrowth of coppice over 10 feet high. In the same way, four years of complete fire protection in Permanent Sample Plot No. 3 has produced a dense growth of *Landolphia*, *Indigofera*, and associated ground cover, with a young underwood of natural regeneration, even under a heavy overwood; while four years of late burning in the adjacent Plot No. 4 have made it a savannah of established trees and grass.

138. Nursery sowings of a number of the more valuable species were made in 1933 in order to estimate the germination capacity of the seeds before starting field trials. A few of the commoner but less valuable species were similarly treated this year. *Brachystegia hockii* (Muputu) germinates well (80 per cent.) if not attacked by mice, *Brachystegia longifolia* (Musamba, Muwombo) gave barely 50 per cent. germination, *Isoberlinia paniculata* (Mutondo) gave the excellent return of 576 plants from 600 seeds (i.e. 96 per cent.). The germination of *Isoberlinia tomentosa* (Mutobo) was again nil, as all the seeds rotted.

139. The following species gave good results with spot sowings at Ndola Nursery and required to be resown to an extent of less than 30 per cent. at the end of the dry season: *Afzelia quanzensis* (Mupapa), *Pterocarpus angolensis* (Mukwa) with shelled seed, *Erythrophloeum africanum* (Kayimbe, Mukoso), *Afrormosia angolensis* (Mubanga). Spot sowings were less successful with *Brachystegia hockii*, *Albizia gummifera* and *Amblygonocarpus obtusangulus*. With *Entandrophragma caudatum* and *Isoberlinia tomentosa* they failed.

140. With spot sowings in Ndola West plantation the series of plots which were cleared, stumped and dug over gave better results than the series in which seed was sown in lines cleared through the bush. Similarly, most indigenous species have shown a higher rate of establishment and a better rate of growth in clean-weeded or mulched plots than in partially or line-weeded plots, and this in spite of the greater soil erosion. At the end of the year 6 of the principal indigenous species were set out as two year old stumped plants. Previous years' sowings and plantings were blanked up.

141. In Chondwe Forest Reserve a group about two acres in extent was cleared and spot sown with *Afzelia*, *Pterocarpus*, *Albizia* and *Erythrophloeum* to test the possibility of regenerating these valuable species by artificial groups.

142. At Mazabuka thinnings were carried out in 20 acres of 7 year old *Cassia siamea* plantations, of which 5 acres were thinned experimentally in different degrees. These thinnings produced more than 5,000 light poles suitable for hut-building, which were used on the station. A further 40 acres were pruned during the year.

143. Damping off, red ants and mice caused more damage in Ndola Nursery than in previous years, especially among germinating *Pinus* species. Mice and beetles spoiled spot sowings of *Brachystegia hockii* in the plantation, and night feeding beetles did considerable damage to the cotyledons of germinating *Afzelia*, *Afrormosia* and *Pterocarpus* when these first appeared above ground. The end of June brought an exceptional frost over large regions in the Western Province. In the country between Ndola and Broken Hill, belts of *Isoberlinia* (Mutondo) woodland extending over hundreds of square miles, were completely scorched by frosts, and became leafless long before their normal time. The fringing forests round the springs and stream banks of the Congo Border watershed also suffered severely. All plants in Ndola West Nursery, except conifers, were badly damaged and *Maesopsis eminii* and *Erythrophloeum guineense* were killed outright.

Conifers.

144. It is pleasing to record that after several years of failure, this year's planting of *Pinus* species at Ndola West has been completely successful. In spite of an exceptionally dry year and an unduly long dry season, the losses since planting in January have been negligible. The good results are due partly to the inoculation of the Nursery soil with mycorrhizal fungus brought specially from Southern Rhodesia. The plants were raised in pots of baked clay, 5 inches tall and bottomless, and were planted in the plantation pot and all. Trial plots of the following were established almost without loss: *Pinus longifolia*, *P. pinea*, *P. canariensis*, *P. maritima*, *P. palustris*, *P. caribaea*, *P. halepensis*, *P. taeda*, *P. engelmannii*, *P. teocote*, *P. muricata* and *P. sabiniana*. At the end of the year further plantings (not, however, exceeding two acres in any one species) were carried out successfully with *Pinus palustris*, *P. caribaea*, *P. insularis*, *P. longifolia*, *P. patula*, *P. engelmannii*, *P. teocote*, *P. muricata*, and with spare stocks of *P. radiata*, *P. canariensis*, *P. pinea* and *P. halepensis*. It is of some interest to note that several species, notably *P. radiata*, *P. caribaea*, *P. teocote* and *P. patula*, imitated the indigenous vegetation by coming into leaf and starting growth during the hot spring weather long before the beginning of the rains.

145. The test plots of Pines at Matonchi (Mwinilunga District) under the care of Captain K. Paterson, were again visited. The spread of mycorrhiza in the Nursery has been slow owing to the lack of humus in the soil. Further inoculations were made towards the end of the year which stimulated the transplants considerably.

146. At Mazabuka the small inoculated Pine plots (30 plants each), which for over 4 years showed considerable promise, provided the only disappointment of the year. A complete plot of *P. longifolia*, averaging 4 feet in height and some of a plot of *P. caribaea* of 6 feet average height, died suddenly at the end of the dry season. These losses appear to have been due to the combined effect of drought and termites at the end of a particularly prolonged and rigorous dry season. It may be, however, that the increasing woodiness of the Pines has rendered them susceptible to termite attack, which hitherto had never penetrated the bark.

Botany.

147. Several weeks were devoted to the Herbarium, which had been neglected since the slump in 1932. A large quantity of material was mounted, labelled and indexed. The draft Check List of Trees and Shrubs, compiled for this Territory by the Imperial Forestry Institute, was thoroughly revised. Identifications of over 300 species collected in North-Eastern Rhodesia by Mr. A. P. G. Michelmores were received from Kew, and good progress was made with the indexing of the duplicate material which he had presented to the Department. Collection of specimens continued and, in particular, good flowering material was obtained of most of the *Brachystegia* species in the railway belt. 129 identifications were received from the Imperial Forestry Institute during the course of the year.

Utilisation.

148. Little time could be devoted to utilisation. The routine annual inspection of a graveyard test for durability against termites was made. The specimens impregnated with arsenic salts all remained intact after four years in the ground, zinc chloride samples were starting to be eaten, and copper sulphate and control samples had all been destroyed except for eight naturally durable species.

Seeds, Plants and Advisory Work.

149. The publication of *The Planting of Trees and Shrubs* by Major E. A. T. Dutton, and the free issue to the general public of plants from the Municipal Nursery at Lusaka has relieved the Department of a good deal of tiresome work. It is hoped that this may enable Forest Officers to devote more time to advice on forest matters in Native Reserves. Suggestions were offered to the Administration in Ndola District for encouraging Native Authorities to draw up rules protecting valuable trees (notably *Pterocarpus*), prohibiting cutting round springs and on stream banks, and enforcing early burning in the large Native Reserves which lie not far from the Mines. Hitherto no rules of this sort have been put into effect in the Native Reserves of the Western Province.

Training of Native Staff.

150. The staff of Forest Guards was doubled this year. Training of recruits had to be done entirely by the Assistant Conservator, as the Department had no African Rangers of sufficient experience to assist in the work. Two courses were held (in June and in December) for instruction of Guards in Forest Law, wood-cutting, early burning, seed collection, making of reports and giving evidence. In an industrial region such as the Copperbelt it has proved by no means easy to recruit Natives who can read and count and at the same time show any inclination for forestry work. Progress in the training of an efficient and responsible Native staff has therefore been less rapid than was, perhaps too optimistically, hoped but the quality of the present staff is undoubtedly improving.

MAZABUKA,

8th February, 1938.

C. J. LEWIN,
Director of Agriculture.
